winter months. Other observers, such as Lamont of Munich, Col. Beaufoy, &c., may be cited in confirmation of the existence of this apparent connection between the vegetative force and that of magnetism, a connection which may perhaps serve to throw some light on the nature of magnetic action. The horizontal force follows a law similar to that of the declination, varying in its daily range with the seasons, and attaining its maximum value in summer.

Another peculiar semi-annual inequality in the diurnal variation has been detected by Mr. Chambers, the times of opposition being the equinoxes. This inequality is found to exist in the observations taken at seven stations—five in the northern, and two in the southern hemisphere. It only lasts from 6 A.M. to 6 P.M., reaching its maximum at 9 A.M. from January to June, and at 3 P.M. from July to December, always passing through the mean value at noon.

If now we turn from the consideration of the effect of the earth's rotation on the direct solar magnetism to examine its influence on that of our satellite, we are again led to expect a positive result, but on very different grounds from those we have just been reviewing. The heat sent to us by the moon, even when full, is so insignificant, that it is requisite to collect the rays in some enormous mirror, such as that of the Earl of Rosse, or to bring them to a focus on a very sensitive thermometer, in order to make it sensible. It would be absurd then to look for any effect that the rotation might produce in the variation of the temperature; but it is very reasonable to expect that the alteration of distance due to the rotation will not be equally insensible. We are not separated from our satellite by more than 240,000 miles, and as the diameter of the earth is nearly 8,000, the rotation may alter the distance of the moon from a station on the earth's surface by about one-thirtieth of the whole distance, and the resulting change of the attracting force must be very considerable. An examination of the Greenwich magnetic observations, arranged according to lunar hours, has led Mr. Airy to the conclusion that no doubt can be entertained as to the existence of a luno semi-diurnal inequality, though he has failed to detect any luno diurnal inequality. He also found so close an agreement between the values of the luno semi-diurnal variation in the years of greater and also of smaller solar curves, that he suggests the two following "conjectural reasons for this remarkable association in the time-law of changes of solar and lunar effect. One is that the moon's magnetic action is really produced by the sun's magnetic action; and a failure in the sun's magnetic power will make itself sensible, both in its direct effect on our magnets, and in its indirect effect through the intermediation of the moon's excited magnetism. The other is, that, assuming both actions, solar and lunar, to act on our magnets indirectly by exciting magnetic powers in the earth, which alone or principally are felt by the magnets, the earth itself may have gone through different stages of magnetic excitability, increasing or diminishing its competency to receive both the solar and lunar action." The ratio of the moon's disturbing action on the horizontal force is to that of the sun as 1 to 20.

We have just been considering the irregularities in the magnetic action of the sun and moon, which arise from the orbital motions of the earth and its satellite, and from the rotation of our globe, but there are still other variations depending on much more complex causes that remain yet to be examined. A very important inequality has been detected in the daily range by several observers, and of late years by Mr. Chambers of the Colaba Observatory. It is a change that takes place in the amplitude of the range, not from season to season, but from year to year, and which completes its cycle in ten or eleven years. Other periodical inequalities of the daily range have been more than suspected, as that of twenty-two years, noticed by Hansteen; and some of these may possibly be found to have a connection with such phenomena as the revolution of the moon's nodes. It will suffice to have mentioned these; but we must not so lightly pass over the decennial period, which is identical with the cycle of those great but irregular disturbances of which we must now say a few words.

The accurate study of magnetic storms was nearly impossible before photography was called to the aid of the observer; but now that every movement of the needle is faithfully recorded by the ever watchful light of the gas jet, a continuous curve shows at a glance the nature, extent, and duration of even the slightest disturbance. The arrangement of these self-recording magnets is extremely simple and equally effective. To each magnet, whose movements we desire to study, is attached a small mirror, and the rays from a gas jet falling on the mirror are sent by it to a cylinder covered with sensitised paper. A lens brings the rays to a focus on the cylinder, and this focus traces on the paper every movement of the magnet. A second mirror fixed immediately underneath the first, but having no connection with the magnet, sends the rays of the gas jet always in the same direction, and thus traces a base line from which the variations of the magnetic curve can be measured with the greatest exactness. A clock turns the cylinder through a complete revolution in twenty-four hours, and the light being cut off for a few minutes every two hours, breaks are thus made in the curve, which serve as an excellent time scale. The magnetic curves, traced in this manner, are in general and lightly irregular lines, which reach their highest point towards 2 P.M., and are more or less curved at all hours of the day. Scarcely a day passes without some apparently accidental departure from the ordinary bend of the line, but these disturbances are often only of short duration. There are, however, occasions on which the magnets seem to be subject to the action of a disturbing force far exceeding in intensity any of those we have been hitherto considering, and subject itself to no apparent laws, but causing the needle not unfrequently to oscillate through several degrees of arc on either side of its mean position. It will be interesting to know what account can be given of this disturbing power, which assumes such Protean shapes, at one time raising a storm that dies away as gradually as it commenced, and at another bursting forth in an instant in all its fury; now continuing its disturbing action for days together, and then imparting but a single momentary impulse; affecting sometimes one element, and then another, and sometimes all together; and finally appearing not unfrequently at the same hour on several successive days.

The coincidence of these disturbances with the passing of earth currents, so perfectly recorded on the Greenwich curves; their never-failing appearance at all auroral displays; their simultaneous occurrence at places the most remote from each other; and lastly the agreement of their period of variation of intensity, as well as their maxima and minima with the decennial period, and the maxima and minima of sun-spot development; all these facts will be most powerful aids towards the solution of our difficulty. Neither is it unreasonable to expect that some light may be thrown upon the question, if we examine with careful attention the not impossible connection of magnetic storms with solar outbursts, or with volcanic eruptions and violent earthquakes, with the variations of the wind, or even with the showers of falling meteors. Much of interest has already been ascertained in connection with these several points, but I will not tax too severely your indulgent patience by entering at present into these details.

I must, however, before concluding, allude for one moment to those researches of De La Rue, Stewart, and Loewy on solar physics, in which they have made a first step towards establishing a connection between the period of solar spots and the relative position of the planets. If this can be maintained; if the solar disturbances are in any way due to the combined action and reaction of the planets, and these again are found to be coincident with the great perturbations of terrestrial magnetism, shall we not be inclined to attribute a wider range to the magnetic force than is in general assigned to it? May not that, which has long been allowed to rank among the most extensively diffused of nature's agents, find a home in each individual member of the solar system, causing them to act and react upon each other as well by their magnetic energy as by their force of gravity? The perfect solution of such a problem would well repay many a year of persevering observation and of assiduous study, and well will those be rewarded by whose labours the general cause of terrestrial magnetism ceases to be one of the unsolved mysteries of cosmical physics.

SCIENTIFIC SERIALS

No. 3 of the *Bulletin de l'Academie Impériale des Sciences de St. Petersburg*, t. xvii., contains seven anatomical papers by Dr. Wenzel Grüber—six on various abnormal muscular forms, and the seventh being an account of the formation of supernumerary wrist-bones.—An appreciative paper on Sir Roderick Murchison is communicated by G. Helmensen. He refers to Murchison's visits to Russia between 1840 and 1845 to study the palæozoic formations. In a *résumé* of results, he mentions, among others, the discovery, in post-pliocene strata in the lower course of the

© 1873 Nature Publishing Group

Dwina, of the shells of species still extant in northern seas; of a Jurassic formation in large zones and fields between the Volga and the Timan Hills, at the western base of the Urals, and in the north-east part of the Caspian lowland; and of two quite distinct coal beds in Central Russia. The writer considers that the work of our countryman has been imperfectly followed up these twenty-five years. He speaks in warm terms of Sir Roderick's friendship for the Russians.—In a note by M. Jacobi, it is suggested to apply galvanoplastic art to the production of standards of length, on the principle that electrodes having the same dimensions and position, baths the same composition and temperature, currents the same intensity, the deposits produced in such circumstances ought to be very nearly equal. Details of such a method are fully given.—A lengthy article by Dr. Hildebrand gives an outline of some 600 historical documents among the archives of the town of Revel, which throw considerable light on the commercial relations of Russia and Livonia in the fifteenth and sixteenth centuries.—The number contains, in addition, two short notes on Faye's comet and the Fossil Cetacea of Europe.

SOCIETIES AND ACADEMIES

LONDON

Entomological Society, Jan. 6.—Prof. Westwood, president, in the chair.—Mr. McLachlan exhibited a collection of coloured figures of the transformations of twenty-one species of Japanese *Sphingidæ*, beautifully executed by a native artist employed hy Mr. George Lewis, long resident in Japan. Prof. Westwood exhibited the net-work cocoon of a small moth from New Granada, attached to a leaf on which was also placed the body of a butterfly (one of the *Hesperidæ*), strongly affected by fungoid growths. Mr. E. Saunders exhibited two species of *Buprestidæ* from the Pelew and Caroline Islands respectively, apparently belonging to a new genus, yet resembling, in external characters, two species of *Chryovdema* from the E. India Islands.—Mr. Champion exhibited two species of *Coleoptera* new to Britain.—Mr. Miller called attention to a recently printed Government report respecting the ravages of the vine-scourge (*Phylloxera vastatrix*). An interesting discussion took place, in the course of which Prof. Westwood stated that, to the best of his belief, the first notice of its occurrence in Europe was made by himself in a paper read before the Ashmolean Society of Oxford regarding its ravages in this country.—Dr. Sharp communicated a paper on the water-beetles of Japan, in which he mentioned that, although there were many European species occurring in the Japanese Islands, yet there was also a considerable admixture of Asiatic forms.—Mr. Wollaston followed by a paper on the *Cossonidæ* of the same islands. He stated that the ordinary European types of that family do not prevail in Japan, but are replaced by kindred or representative forms. Mr. Pascoe thought that the fauna of Japan, like that of Madagascar or New Zealand, might be termed a satellite fauna, which, while having many endemic forms, had yet a great deal in common with the neighbouring continent. Mr. Bates asked that judgment upon the question be suspended; although many Western European species were also found in Japan, the collective faunas of the two regions were totally different, and if they found only one fauna in common, the majority of the genera ought to be the same, which was apparently not the case.

PHILADELPHIA

Academy of Natural Sciences, June 11, 1872.—Professor Cope offered some remarks on the discoveries recently made by Professor Marsh as to the structure and characters of the *Pythonomorpha*, based especially on material recently obtained by him in Kansas. As the writer had recently passed in review much similar material, he was much interested in Prof. Marsh's conclusions. These, he said, were of importance. In the first place, he had ascertained that what was formerly supposed to be the inner side of the quadrate bone was the outer side, a conclusion Prof. Cope thought entirely consistent with the other known relations of the parts. Secondly, he had discovered the stapes, and had entirely confirmed the opinion of the speaker, which Prof. Marsh had apparently overlooked. This was stated as follows:* the quadrate "is characterised by the presence of an oval pit. . . . Its use is uncertain, but there is some probability that it received the extremity of an osseous or cartilaginous styloid stapes. A groove on the under side of the suspensorium would accommodate such a rod, and in a position nearly similar to that which it occupies in many of the Ophidia." It is in precisely this position that Prof. Marsh is so fortunate as to have discovered it. Thirdly, Prof. Marsh believes that he has found the columella. I have supposed it to be wanting, from the absence of its usual points of attachment on the parietal and pterygoid bones. It remains to compare the bone found by Prof. Marsh with ali-and orbito-sphenoid and ethmoid ossifications found in many saurians. Fourthly, Prof. Marsh has observed the parieto-quadrate arch described by the speaker, and makes the interesting observation that it is formed of three elements, the median connecting the parietal with the opisthotic. This piece, he says, is "apparently the squamosal;" as the latter bone completes the zygomatic arch, it cannot occupy a position in the parieto-squamosal, unless it sends a branch in that direction. Fifthly, he discovers the malar arch, proving it to be incomplete and supported by the postfrontal bone. Prof. Marsh also observes an ossification in the glenoid cavity of the opisthotic, which he regards as the pterotic (of "Huxley," which should be Parker), an identification which cannot probably be maintained. The connections of the pterotic, where present, are very different. The bone in question is present in *Edestosaurus tortor* Cope. Sixthly, Prof. Marsh completes almost entirely our knowledge of the anterior limbs. The previous descriptions of these members in *Clidastes propython* Cope, *Holcodus ictericus* Cope, and other species, had left the number of phalanges and their relative positions, as well as those of the carpals, uncertain; these points are now happily supplied by Prof. Marsh's important researches. Seventhly, he has done much for the pelvic arch and hind limbs. He was the first to announce the existence of both, and actually described the pelvis of *Edestosaurus dispar*; the speaker, however, first described the hind limb in *Liodon crassartus* and *L dyspelor* Cope. Prof. Marsh is in error when he says the "absence of these extremities in the *Pythonomorpha* was considered satisfactorily established." I had never stated that they were certainly absent, and the last time I wrote observed that this order "possessed an anterior pair only, or with the posterior pair so reduced as to have been insignificant."* They appear, according to Marsh, to have been relatively small in some of the genera. In *Liodon dyspelor* Cope, the anterior are the smaller. Prof. Marsh lays students under especial obligation for his determinations of the pelvic elements and the excellent figures of all the parts connected with the support of the hind limb. His figure of the fore limb is also highly important, as it will be difficult soon to duplicate his beautifully complete specimen. In subsequent pages there are six additional species described, bringing up the number from the Kansas Cretaceous to twenty-three. Two new genera are proposed, viz., *Lestosaurus* for those previously referred by myself to *Holcodus* Gibbes, and *Rhinosaurus* for species allied or belonging to *Liodon*. As to the former, it is no doubt a well-marked genus, and I am willing to believe Prof. Marsh's opinion, that it will not include Gibbes' *Holcodus acutidens*, will turn out to be well-founded; but there is, on the other hand, insufficient evidence to show that it is not *Platecarpus* Cope. If *Liodon curvirostris* be referred to it, it will very probably prove to be *Platecarpus*, as that species presents palatine teeth, much as in *P. tympaniticus*, and the pleurodont character is not wanting in some of the other species. *Rhinosaurus* includes such species as *Liodon proriger* Cope. As the name has been used two or three times before, it may be altered to *Rhamphosaurus*, but I have always had doubts that the conic projecting snout would distinguish the species generically from the true *Liodon*, with which it agrees in dentition. The type of *Liodon*, *L. anceps* ord., is, however, very little known.

PARIS

Academy of Sciences, Dec. 23, 1872.—M. Faye, president, in the chair. M. Mathieu presented the *Connaissance des Temps* for 1874 from the Bureau des Longitudes; Lieutenant Fleuriais' determinations of the meridians of Shang-hai and Pondicherry are adopted in this number. The president then read a paper on the true position of the Bureau des Longitudes. It has been proposed in the National Assembly to suppress the Bureau in order to save its cost to the nation, the president's paper was an eloquent defence of and appeal for the threatened institution.—M. Becquerel read a paper on the use of electro-chemical and electro-capillary force for the formation of amalgams and crys-

---

* Trans, Amer, Philos. Soc. 1869, p. 180.

* Hayden, Geol. Survey of Wyoming, etc., 1870 p. 385.

© 1873 Nature Publishing Group